VIII. AN ACCOUNT

OF THE SPRINGS AND WELLS ON THE PENINSULA OF BOSTON, WITH AN ATTEMPT TO EXPLAIN THE MANNER IN WHICH THEY ARE SUPPLIED:

In a letter to the Hon. John Davis, Esq. Recording Secretary of the American Academy of Arts and Sciences.

BY JOHN LATHROP, D. D. F. A. A.

Boston, May 10, 1800.

SIR,

HAVING employed some leisure hours in collecting materials for a statistical account of the place in which I live, agreeably to the plan of Sir John Sinclair, I send you the following account of Springs and Wells, which afford the inhabitants a great supply of fresh water.

Although the narrow limits of the ground, on which Boston is built, do not admit of a river, or even a small brook, the Author of nature, in his infinite wisdom and goodness, hath provided an ample supply of excellent water, which may be always obtained, and at little expense. This supply is either from springs, which rise to the surface, or from wells, which in some parts of the town are not more than 15 or 20 feet deep, although in other parts of the peninsula they are sunk to the depth of 100 or 120 feet.

The first writers of the history of New England tell us, Governor Winthrop and his associates were invited to leave Charlestown, and come over to Shawmut, by a Mr. Blaxton, who informed them he had found "an excellent spring." What spring Mr. Blaxton had respect to in his invitation we cannot say; it is probable

however it was the spring now to be seen on the westerly part of the town, near the bay, which divides Boston from Cambridge.

In the early records of the town mention is made of *the great spring*, which discharged its water into what is now called Spring Lane, leading from Cornhill to Devonshire Street. The population of the town made it necessary many years ago to cover up this spring, the water of which now passes under ground and supplies many families, at a considerable distance from the place where it was open, when " our fathers drank thereof, with their children and their cattle." Springs and running streams have been found in many parts of the peninsula, and some of them but a few feet from the surface, which afford excellent water, and in great abundance.

In the history of the wells which have been dug in various parts of the town, there are circumstances to engage the attention of the naturalist. In a history of this sort, attention should be given to the *strata*, through which the workmen pass ; the *springs* and *currents* of water, which are opened ; the *elevation*, to which the water rises ; the *quality* of the water, whether fresh or salt, hard or soft, sweet or fetid, clear or foul ; together with the *temperature*. A complete natural history of the waters which supply the town would require more time than I can spare, and more knowledge than I possess. I will however relate such things on the subject as I have observed ; others I hope will bestow more attention, and furnish a more perfect account.

The first well, to which I have given attention, is the one lately dug on the southeasterly side of Beacon Hill, to accommodate the new State House. This well is opened at the side of the hill, at a level of about 35 feet from the top of the hill, and is 96 feet deep. The hill rises 138 feet and 6 inches above the level of the sea, which surrounds the peninsula. The bottom of the well is therefore 7 feet and 6 inches above the level of the sea.

The strata, as nearly as I could ascertain, are the following.

	ft.	inch.
1. Mould and yellow earth	0	6
2. Yellow earth with sand	1	6
3. Yellow sand with small stones, slate and quartz	5	0
4. Fine gray sand	6	0
5. Gray sand of a coarser sort, with small stones	6	0
6. Fine, soft, yellow sand	4	0
7. Gray sand with slate and quartz	5	0
8. Blue clay, with small stones of the same colour, and very little variation	63	0
9. Indurated clay, with larger stones, of the slate kind chiefly; one with ferruginous veins, and an incrustation of calcareous matter, which effervesces with an acid	3	0
10. A mixture of clay and gravel and water, with smooth stones, like those commonly found on the sea shore, and appear as if rubbed against each other	2	0
	96	0

No spring was found in any of the strata, until the workmen entered on the last. After digging a foot, or a foot and a half, in the last stratum, the bottom became so soft, and the water came in so fast, that the workmen were obliged to desist. The well was stoned and finished.

Having been informed, that the depth of water was different at different times, I determined, if possible, to ascertain the fact, and satisfy myself whether the ebb and flow agreed with the ebbing and flowing of the sea. On the tenth of October, 1797, at low water I measured and found 7 feet and 11 inches. The next day at high water I measured, and found 8 feet and 11 inches; difference one foot. On the twelfth of July, 1798, at high water, and on the day before the change

of the moon, I measured, and found 12 feet and 5 inches. It not being convenient to measure again exactly at low water, I measured about an hour and a half after the tide began to come in, and found 11 feet and 9 inches; difference 8 inches. These several trials afford sufficient evidence, that the water rises and falls in this well, regularly with the tides. As the bottom of the well is 7 feet and 6 inches above the level of the sea, and the water is found to rise 12 feet and 5 inches, its elevation may be about 20 feet above the level of the sea. The water in the well is uncommonly soft: it has no fetid smell or taste: it readily dissolves soap, and is used for washing and drinking by the people who have access to it.

The clay which is held in suspension gives the water a bluish cast, but by dispelling the air, I found the sediment less, than from the water of the wells in general which I have examined. The faint effervescing of the sediment with an acid, showed the presence of a small quantity of calcareous matter.—By plunging a thermometer into a large bucket of water drawn from the well, I found the temperature, from several trials, to be between 48 and 50; varying not more than one and a half, with the extremes of heat and cold, in summer and winter.

The provision which the Author of nature has been pleased to make to supply the hills on the peninsula with water, and to raise it in some places to 75 or 80 feet above the level of the sea, is to be acknowledged with gratitude. On the north, as well as on the south side of Beacon Hill, and on the range of high ground connected with it, many springs are found, at a little depth from the surface, and some of them seem inexhaustible. Near the mansion house of the late Governor Bowdoin is a spring of this sort. The well, I am informed, is about 16 feet deep. It is supplied with a spring, which comes in near the bottom, and has never failed in the driest seasons. The water is of an excellent quality. It rises nearly to the top of the well;

and from the elevation of the ground, the water might be sent, in refreshing streams, to the greatest part of the town. The comfort, which the inhabitants might receive in the heat of summer, from streams sent to them from the hills, which the Author of nature hath given us, not more for ornament than for use, would be very great; but while this comfort is quite at command, it has hitherto been neglected. As advantages of high importance result, and may be caused still farther to result from the hills, which are placed on this peninsula, it is to be hoped, those hills will be regarded with a kind of religious respect, and that the municipal authority will never suffer their venerable heads to be brought low.

To give some account of the depths below, as well as the heights above the level of the sea, from whence water is taken for the supply of the town, I will mention what I have been told, relating to some of the deepest wells in the town.

An intelligent proprietor of the well made a few years since, near the old fortification, at the southwesterly entrance from the neck, gave me the following history of it.—Where the ground was opened, the elevation is not more than one foot, or one foot and a half, above the sea, at high water. The well was made very large. After digging about 22 feet in a body of clay, the workmen prepared for boring. At the depth of 108 or 110 feet, the auger was impeded by a hard substance. This was no sooner broken through, and the auger taken out, than the water was forced up with a loud noise, and rose to the top of the well. After the first effort of the long confined elastic air was expended, the water subsided about 6 feet from the surface, and there remains at all seasons, ebbing and flowing a little, with the tides.

Observing a small pump, placed by the side of a large one, in the same well, I was led to ask for what purpose it was placed there, and was told, that the water in the well, which was at first exceeding fine

and soft, and without any fetid smell or taste, after some time was found to be less pleasant, and less fit for general use. However, as it rose so near the surface, curiosity led the proprietors to let down a proof glass, to taste the water, and it was found much better, when taken thus from the top, than when pumped from the bottom of the well. Although from the same fountain they did not take "salt water and fresh," in the same well they found *soft* water and *hard*, *sweet* water and *fetid*. The small pump was then placed by the side of the large one, which, entering but a little way, took water fit for every use, and free from any unpleasant smell. Whether the water becomes unpleasant by a subtle *mephitick* vapour, which finds its way into it, or by being covered up, as wells commonly are, and thus deprived of *oxygen* from the atmosphere, is worthy of careful examination. I would just observe, the proprietors of the well last mentioned were led to exercise great caution in carrying on the work, by an accident which happened very near them a few years before. A few years before, an attempt was made to dig a well about twenty rods to the east, near the sea. Having dug about 60 feet in a body of clay, without finding water, preparation was made in the usual way for boring; and after passing about 40 feet, in the same body of clay, the auger was impeded with stone. A few strokes with a drill broke through the slate covering, and the water gushed up with such rapidity and force, that the workmen with difficulty were saved from death. The water rose to the top of the well and ran over for some time. The force was such as to bring up a large quantity of fine sand, by which the well was filled up many feet. The workmen left all their tools behind, which were buried in the sand, and all their labour was lost. The body of water, which is constantly passing under the immense bed of clay, which is found in all the low parts of the peninsula, and which forms the bason of the har-

bour, must have its source in the interiour, and is pushed on with great force, from ponds and lakes in the elevated parts of the country. Whenever vent is given to any of those subterranean currents, the water will rise, if it have opportunity, to the level of its source.

But I must desist, having, I fear, taken up too much of your time; although there is yet *truth in the well*, sufficient to engage the attention of the humble inquirer.

With great respect and esteem,

I am,

Sir,

your most obedient servant,

JOHN LATHROP.

Hon. JOHN DAVIS, Esq.

SUPPLEMENT

TO THE FOREGOING COMMUNICATION.

Boston, August 18, 1800.

DEAR SIR,

THE force with which water is observed to rise in many of the wells which have been dug in the low parts of the peninsula of Boston, and the elevation which it holds in the wells on the hills, excite a strong curiosity to find the sources of the springs, and to understand the machinery, by which the water is forced so much above the level of the sea. I now hazard a few thoughts on this part of the natural history of springs, which you will please to consider as a supplement to the last communication on this subject.

On this peninsula there are what I shall take the liberty of calling, the *upper* and the *nether* springs. The upper springs are those which are found in the hills, and at a moderate distance from the surface, together with those which discharge their waters, at openings which they have worked for themselves. The nether springs are those which are found under a body of clay, from 80 to 120 feet deep.

We are now to inquire for the sources of the springs of both kinds, which are found on the peninsula, and endeavour to account for the height at which water rises in the wells. The sources, I believe, cannot be found on the peninsula. By the laws of hydrostatics, water can rise in wells no higher than the reservoir. Some of the ancients supposed all springs and fountains of fresh water have their origin in the sea, and that in passing subterraneous ducts, the sea water loses its saltness by percolation. But as sea water can be admitted into the wells in Boston, only through veins of sand or gravel, it is not conceivable, that in passing so short a distance, (in many places but a few feet) it can lose all its saltness. But were that supposable, there is an objection to the theory from the *height* to which spring water rises.

The sea can raise water only to its own level; whereas the water rises in some of the wells in Boston 75 or 80 feet above the level of the sea. Were the hills on the peninsula high and large enough to contain caverns in their bowels, or admit of basons, for ponds on their tops, the quantities of water, received direct from the atmosphere, might be sufficient to keep the springs at their foot always full. But Beacon Hill, the highest of the three, is only 138 and a half feet. Its shape is such, that the vapours which are attracted to it, and the rains which fall upon it, must run quickly down its steep sides to the sea. While the electric principle, which the upper strata possess, may be continually attracting the surrounding vapours, the sands, of which

those strata are composed, cannot retain the waters they imbibe, but must discharge them either from the sides, or convey them to the deep stratum of hard earth and clay, which is found in the centre of the hill. As this stratum is very compact, and conforms, as all the others do, to the shape of the hill, the water, which is filtered through the sands above, cannot enter it; but must pass down its convex surface, without affording any supplies to the springs which are found below it. No reservoir can be found in the hills, on the peninsula, sufficient to raise water in the wells 75 or 80 feet above the level of the sea. Nor is it less difficult to find the sources of the lower springs, without going to some distance. Under a stratum of clay, generally more than 100 feet thick, which is found in all the low parts of the town, there are waters, either in veins of sand and gravel, or in currents, passing continually to the sea. Whenever those veins or currents are opened by the spade or auger of the well digger, water is forced up with violence, and in some cases flows over on the ground.

As reservoirs are not to be found on the peninsula, sufficient to supply the springs, and to raise the water in wells so much above the sea, where shall we look for them? I believe we must look into the country. All the waters, which are collected in the mountains, and elevated parts of the earth, are constantly pressing towards the ocean. The waters in the rivers make their way without much difficulty; while those immense bodies, which are confined in the great lakes, and in ponds, some of which are many miles in circumference, are constantly pressing on the sides and seeking a passage in veins of sand and gravel, which are found at different depths, and convey water wherever their courses are directed.

While we look to the mountains, some of which rise above the ordinary course of the clouds, in every quarter of the world, as the *original* sources of springs and rivers, the sources of the springs on our

peninsula may be found nearer home. The ponds at the northward, at the west, and southward, have a sufficient elevation, and, as *reservoirs*, contain quantities of water, sufficient to furnish innumerable springs, between them and the sea. Let us suppose, that under some pond, several miles from Boston, there is placed a stratum of clay, which serves as a bason to prevent the water from sinking into the earth, and that next to the stratum of clay there is placed a vein of gravel, and over that clay again, or hard earth, (as we find strata commonly disposed) and we may conceive of a complete aqueduct, from the pond to the sea. If the pond be very deep, veins of sand or gravel, between strata of clay, at different distances from the surface, may furnish supplies for the springs on the elevated parts of the peninsula, as well as for those which are found at 100 or 120 feet under a bed of clay.

In the drawing annexed, the pond and stratum of gravel between strata of clay, may be considered as one leg of an inverted syphon; the well dug in the side of the hill, and which just enters the vein of gravel and water, may be considered as the other leg. The pressure on the pond would raise the water in the well to the same level, if the syphon was complete. But it is to be remembered, while a part of the water is forced up the well, where the passage is easy, probably much the greatest part, which comes from the source, is still carried along in the vein of gravel. It is impossible for us to say *why* the water holds a certain elevation, and rises no higher, while we are unacquainted with the degree of obstruction, which it meets with in its original course. If the obstruction is great, so that the water has very little motion, where the vein is opened, it will rise high in the well; but if the passage is comparatively easy, the depth of water in the well will not be great. At a certain elevation the water in the well will be a balance for the pressure at the source, (allowing always for the force

which is expended in pushing along that portion of the water, which still keeps its original course). Although the drawing is not perfectly correct, it may serve in some measure to illustrate the theory of springs, and the manner in which water is raised in them.

On the preceding principles we easily account for the ebbing and flowing of the water in wells, near the sea. The pressure of the tide against the mouths of the subterranean aqueducts will prevent for a time the passage of the water; of course the water will rise in the wells, which are supplied by those aqueducts. When the tide falls, the water will fall in the wells, situated as now supposed.

Thus does the Almighty "send springs into the vallies, which "run among the hills: they go up by the mountains, they go down "by the vallies, unto the place which is appointed for them."

With great consideration

I am

your obedient humble servant,

JOHN LATHROP.

Hon. JOHN DAVIS, Esq.

REFERENCES TO FIG. XI.

a A pond of fresh water several miles distant from Boston.

b b b b Strata of earth, gravel, clay and gravel.

c Salt water between Boston and Cambridge.

d Beacon Hill.

e Part of Long Wharf.

‖‖ Wells of water, communicating with veins of gravel or sand at different depths.

--- Small veins of sand or gravel, which convey water from larger veins to the surface of the earth, and break out in springs.

– – Stones of different kinds; chiefly slate.

Fig. 15.

Fig. 12.

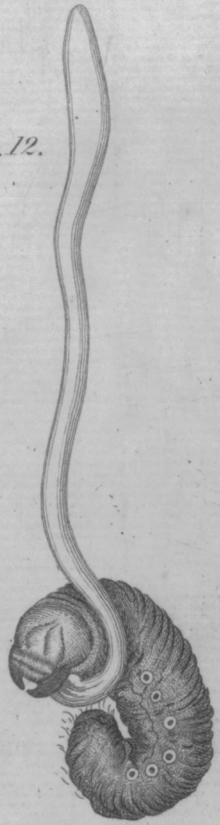

Fig. 16.

Fig. 18.

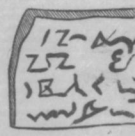

Fig. 17.

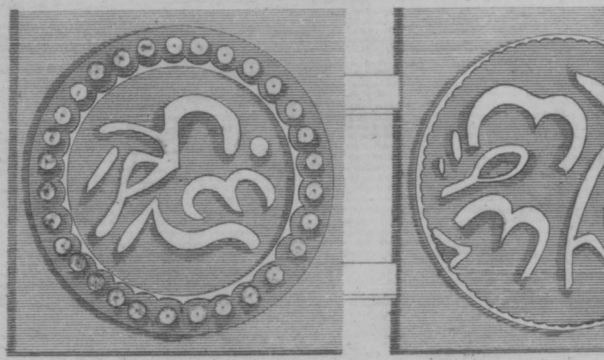

Fig. 11.

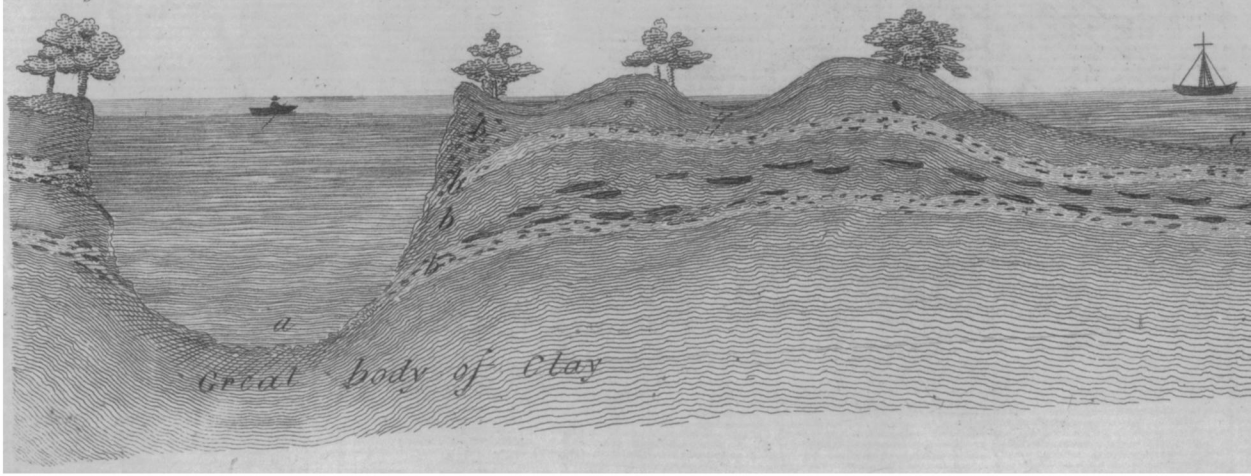

Fig. 15.

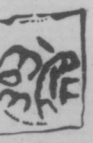

Fig. 18.

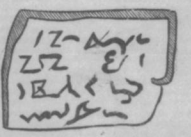

Fig. 14.